

EECE 360 Homework - Nyquist Plots

- 1) You are the new ECE360 Instructor and need to create a Nyquist quiz question. Identify the minimum components an open-loop transfer function must have in order for students to demonstrate the following abilities. Create an open-loop transfer that has all of these components but results in a question that is **AS EASY AS POSSIBLE**.
 - has a gain margin
 - has a phase margin
 - has a cross-over frequency
 - requires you to define a modified Nyquist contour

Use the following Matlab code to check your question:

- `KGH = pzk([vector of poles], [vector of zeros], GainValue);`
 - `nyqlog(KGH);`
 - `% The following step is optional`
 - `bodeplot(GainValue, PoleVector, ZeroVector, 6);`
- 2) Solve the problem by hand.
 - 3) Modify your problem so that it has both a positive and a negative gain margin. Solve the problem by hand.
 - 4) Modify your problem so that it is unstable. Solve the problem by hand.
 - 5) Modify your problem so that it has an OPEN-LOOP pole in the RHP but the closed-loop system is stable. Solve it. Show how the Nyquist criteria ($N=Z-P$) confirms that it is stable.

- 6) For the following open-loop transfer functions, roll a 6-sided die five times to obtain values for a, b, c, d and e. Draw the corresponding Bode plot. Determine whether or not the system is stable

If the system is stable:

- identify the gain margin
- identify the phase margin
- identify the cross-over frequency

If the system is unstable:

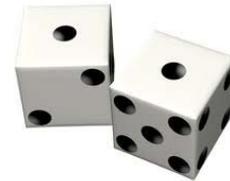
- compute the required gain adjustment for stability
- compute the required phase adjustment for stability
- identify the cross-over frequency

Use the Matlab function specified above to check your answer:

$$KGH = \frac{10^a}{(s + 10^b)(s + 10^c)(s + 10^d)(s + 10^e)}$$

$$KGH = \frac{10^{a+2c}(s + 10^b)}{(s + 10^c)^2(s + 10^d)}$$

$$KGH = \frac{10^{a+c}(s + 10^b)}{s^2(s + 10^c)^2}$$



$$KGH = \frac{10^{a+3d}(s + 10^b)}{(s + 10^c)^2(s + 10^d)^2}$$

$$KGH = \frac{10^{a+3c}s(s + 10^b)}{(s + 10^c)^2(s + 10^d)^2}$$

- 7) Ask your lab partner to give you all of their questions from this assignment and solve them.